This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found here.

If you have a suggestion to make the keys better, please fill out the short survey here.

Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.

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1. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{1950}{10}} + \sqrt{182}i$$

The solution is Nonreal Complex, which is option B.

A. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

B. Nonreal Complex

* This is the correct option!

C. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

D. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

E. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

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2. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{21}{0}}$$

The solution is Not a Real number, which is option C.

A. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

B. Irrational

These cannot be written as a fraction of Integers.

C. Not a Real number

* This is the correct option!

D. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

E. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\sqrt{\frac{21}{0}}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

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3. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{484}{169}}$$

The solution is Rational, which is option A.

A. Rational

* This is the correct option!

B. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

C. Irrational

These cannot be written as a fraction of Integers.

D. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

E. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\frac{22}{13}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

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4. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{27 - 22i}{-1 - 7i}$$

The solution is $2.54 + 4.22i$, which is option C.

A. $a \in [-27.5, -26.5]$ and $b \in [2.5, 4]$

$-27.00 + 3.14i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [-4.5, -3]$ and $b \in [-4, -3]$

$-3.62 - 3.34i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

C. $a \in [1, 3.5]$ and $b \in [4, 5.5]$

* $2.54 + 4.22i$, which is the correct option.

D. $a \in [126.5, 128.5]$ and $b \in [4, 5.5]$

$127.00 + 4.22i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [1, 3.5]$ and $b \in [210.5, 211.5]$

$2.54 + 211.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

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5. Simplify the expression below and choose the interval the simplification is contained within.

$$11 - 16^2 + 12 \div 14 * 7 \div 4$$

The solution is -243.500, which is option C.

A. $[268.3, 269.8]$

268.500, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

B. $[264.2, 267.3]$

267.031, which corresponds to two Order of Operations errors.

C. $[-243.8, -241.2]$

* -243.500, this is the correct option

D. $[-246.8, -244.4]$

-244.969, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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6. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{-27 - 55i}{4 + i}$$

The solution is $-9.59 - 11.35i$, which is option B.

A. $a \in [-11, -9]$ and $b \in [-194, -191]$

$-9.59 - 193.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

B. $a \in [-11, -9]$ and $b \in [-12, -10.5]$

* $-9.59 - 11.35i$, which is the correct option.

C. $a \in [-3.5, -2]$ and $b \in [-16.5, -14]$

$-3.12 - 14.53i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

D. $a \in [-163.5, -162.5]$ and $b \in [-12, -10.5]$

$-163.00 - 11.35i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [-7, -6]$ and $b \in [-56, -54]$

$-6.75 - 55.00i$, which corresponds to just dividing the first term by the first term and the second by the second.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

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7. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{64}{625}} + 64i^2$$

The solution is Rational, which is option E.

A. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

B. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

C. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the number).

D. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

E. Rational

* This is the correct option!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

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8. Simplify the expression below and choose the interval the simplification is contained within.

$$3 - 10^2 + 1 \div 20 * 15 \div 18$$

The solution is -96.958, which is option C.

A. $[103.02, 103.06]$

103.042, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

B. $[102.99, 103.01]$

103.000, which corresponds to two Order of Operations errors.

C. $[-96.98, -96.94]$

* -96.958, this is the correct option

D. $[-97.01, -96.99]$

-97.000, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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9. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(8 - 10i)(6 - 5i)$$

The solution is $-2 - 100i$, which is option C.

A. $a \in [-2, 1]$ and $b \in [94, 105]$

$-2 + 100i$, which corresponds to adding a minus sign in both terms.

B. $a \in [95, 100]$ and $b \in [20, 22]$

$98 + 20i$, which corresponds to adding a minus sign in the first term.

C. $a \in [-2, 1]$ and $b \in [-102, -98]$

* $-2 - 100i$, which is the correct option.

D. $a \in [95, 100]$ and $b \in [-23, -14]$

$98 - 20i$, which corresponds to adding a minus sign in the second term.

E. $a \in [46, 49]$ and $b \in [45, 53]$

$48 + 50i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

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10. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-2 + 10i)(-9 + 6i)$$

The solution is $-42 - 102i$, which is option A.

A. $a \in [-44, -38]$ and $b \in [-105, -101]$

* $-42 - 102i$, which is the correct option.

B. $a \in [-44, -38]$ and $b \in [99, 103]$

$-42 + 102i$, which corresponds to adding a minus sign in both terms.

C. $a \in [16, 25]$ and $b \in [58, 61]$

$18 + 60i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

D. $a \in [78, 84]$ and $b \in [-84, -75]$

$78 - 78i$, which corresponds to adding a minus sign in the second term.

E. $a \in [78, 84]$ and $b \in [78, 83]$

$78 + 78i$, which corresponds to adding a minus sign in the first term.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.